Service Manual

EC1 Body-Pack Transmitter

Characteristics

General

This transmitter is a single-channel unit that operates in the VHF band between 169.445 and 230.000 MHz. Its phase-locked loop (pll) circuit is programmable, enabling a factory-authorized technician to change the transmitter's carrier frequency. The unit is approved by the European Telecommunications Standards Institute (ETSI) and other authorities, and is sold in Europe and many other parts of the world.

The EC1 is typically used with the Shure EC4 diversity receiver and a lavalier (WL93, WL183, WL184, WL185), headset (WH10, WCM16), or instrument (WM98) microphone.

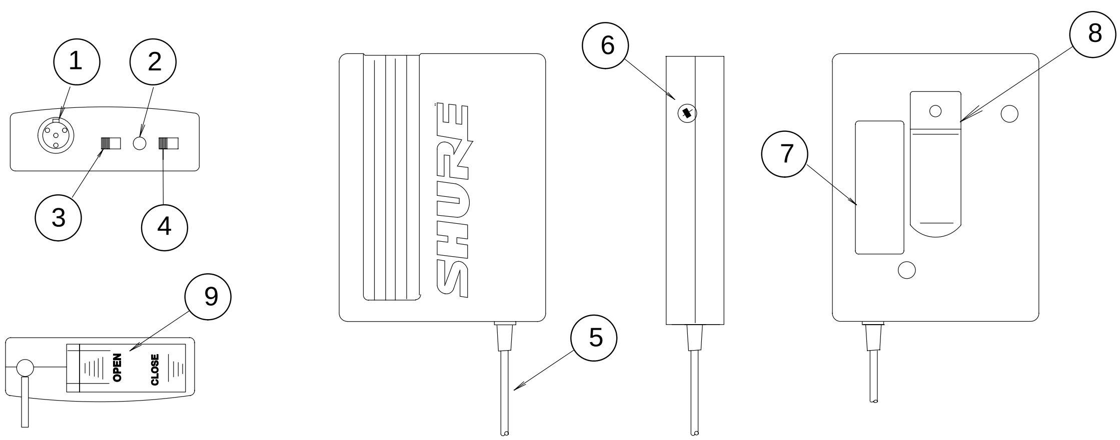

Figure 1.

1. Input jack
2. "Power" LED
3. Microphone on/off switch
4. Power on/off switch
5. Antenna
6. Audio level control
7. Frequency label
8. Belt clip
9. Battery compartment

Service Note: Shure recommends that all service procedures be performed by a factory-authorized service center or that the product be returned directly to Shure Brothers Inc.

25A1002 (RA)

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Circuit Description

The Shure EC1 transmitter has two interconnected circuit boards, which comprise the audio and rf sections, respectively, plus a small audio filter board mounted directly to the input connector.

Audio Section

Input: Audio signals enter the EC1 by way of a four-pin miniature Tini Q-G (quick-ground) audio connector:

- **Pin 1:** *Ground*
- **Pin 2:** *Regulated 5 Vdc bias for electret condenser microphones*
- **Pin 3:** *Audio input*
- **Pin 4:** *20 kΩ load resistor connected to pin 3 for Shure electret microphones*

The rf filtering networks on pins 2 and 3 prevent the radiation of spurious signals via the audio input cable and prevent strong rf fields from disrupting the preamplification and bias-voltage circuits.

Preamp: The audio signal next enters a preamplifier (transistors Q101 and Q102). An externally-accessible variable gain control (R115) provides up to 40 dB of gain, enabling the user to compensate for level differences at the source. Low-pass filtering restricts the bandwidth of the system to audio frequencies.

Pre-emphasis Network and Compander: The amplified audio signal then passes through a 62-microsecond pre-emphasis network (C105, C106, R105, and R107). The output is fed to an NE571D compander (U101A), which uses an external buffer transistor (Q103) to improve the signal-to-noise ratio. The compander performs 2:1 logarithmic compression of the audio signal to effectively limit the peak deviation and spectral bandwidth of the transmitted signal. An internal potentiometer (R131) nulls the system audio distortion.

5 Vdc Bias and "Power" LED: The NE571D's identical second channel (U101B) supplies regulated, low-noise 5 Vdc bias to various audio and rf circuit points. Transistor Q104 provides input bias for the compander section (U101A), and transistor Q105 drives LED D101, which serves as a "Power On" and low-battery indicator. Transistor Q106 provides electronic reverse-polarity protection.

Output and Mute: The processed audio signal enters unity-gain inverting amplifier U106A, whose output feeds the rf printed circuit board through connector J101. The *Mute* switch (S102) controls the audio signal for standby operation without shutting off the carrier.

RF Section

Audio Input: Processed audio enters R204, an internal potentiometer that is factory-adjusted for 15 kHz deviation (100% modulation) when the audio section provides a 0 dBu (0.775 V), 1 kHz tone.

Voltage-Controlled Oscillator (VCO) Assembly

This assembly is represented as "A201" on the rf schematic; its circuitry is detailed in the separate vco schematic.

Oscillation: The signal from R204 enters the audio input of voltage-controlled oscillator (vco) assembly A201. This feeds the signal to varactor diode D401, which is part of a common-gate Colpitts oscillator (Q401). This vco stage operates directly at the carrier frequency.

Filtering and Frequency Stability: The oscillator output is coupled by C410 to Q402, a GaAs MESFET (gallium-arsenide metal-oxide semiconductor field-effect transistor) buffer stage, which isolates the vco from subsequent circuits. A seven-pole, low-pass filter is added to the output of the buffer. These two stages are shielded to prevent external rf fields from affecting their operation and to reduce harmonic radiation from the oscillator. Regulated 5 Vdc power ensures frequency stability despite changes in battery voltage. The use of a phase-locked loop (pll), frequency-synthesized system eliminates the need for multiplier stages, resulting in a much higher degree of spectral purity.

At this point the rf signal splits into two paths. The output of the vco assembly described above is coupled by C208 to the frequency-control section, and by C213 to the rf output section.

Frequency Control

Frequency Control: An MB504L prescaler (U202) is programmed by an MC145152 synthesizer (U201) to divide the signal by 32 or 33 to derive the comparison frequency. The synthesizer contains a quartz-controlled reference oscillator circuit operating at 6.4 MHz (Y201), which is factory-calibrated by trimmer C243. Internal circuitry divides this signal by a factor of 128 to produce a 50 kHz reference frequency. The factory programs the operating frequency of each unit by 13 solder jumpers on the rf printed circuit board, which control the internal synthesizer divider circuitry.

DC Control Voltage: The synthesizer output, a series of pulses, is integrated by loop filter U203 to provide a dc control voltage for the vco. This voltage is fed back to varactor diode D402 in the vco assembly. The factory adjusts trimmer capacitor C409 to center the vco frequency within the lock range.

RF Output

Power Amplifier: In the signal path, transistor Q201 operates as an emitter follower to provide impedance-matching. The output of this stage is coupled via C221 to the final output stage Q204, which operates as a tuned amplifier. The output of Q204 contains a four-pole tuned circuit (L205, C228, C226, L208, and C227).

Output Filter and Antenna: A dual-pi-section low-pass filter (C229, L206, C230, L207, C246, C247, and L209) further reduces any harmonic energy that remains. The 50 Ω filter output is connected to the antenna, a quarter-wavelength, permanently attached, flexible wire. The pcb ground serves as a counterpoise.

Transmitter Output: The transmitter can deliver up to +17 dBm (50 mW) to the antenna. No user adjustments permit this value to be ex-

ceeded. The unit is intended to be powered exclusively by a 9 Vdc battery (an alkaline type, such as a Duracell MN1604, is recommended).

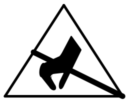
Spurious Emissions: To minimize the production and radiation of spurious emissions and harmonic energy, and to promote stable operation, the collector circuit of each rf stage is separately decoupled from the nine-volt supply by ferrite chokes and bypass capacitors. The base circuits, which are all operated from the regulated five-volt supply, are similarly decoupled except that they use resistor-capacitor (RC) networks, which are more appropriate for the higher impedance level.

Functional Test

Before disassembling the unit, operate it to determine whether it is functioning normally. Review the customer's complaint and focus your tests on it. See the product User's Guide for a description of the unit as well as information on its operation, troubleshooting, and technical data.

Disassembly and Assembly

To access the pc boards, disassemble the unit.



! CAUTION

Observe precautions when handling this static-sensitive device.

Disassembly

1. Slide open the battery-compartment cover and remove the battery and, if necessary, the serial-number and date-code labels.
2. Remove the two smaller-head Phillips screws from the back of the case (it is not necessary to remove the belt clip).
3. Carefully separate the top and bottom halves of the case to expose the pc boards.
4. Grasp the edges of the pc boards, as well as the front control panel, and remove them as a unit by gently lifting them up and out of the case.
5. Remove the rubber grommets from between the pc boards.

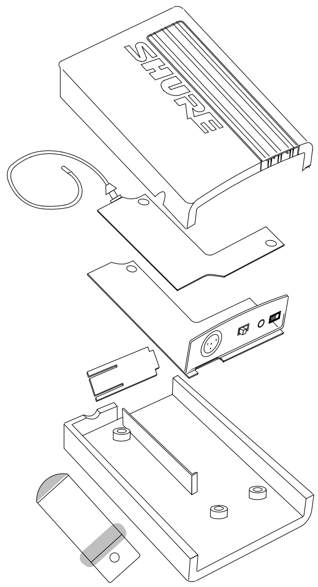


Figure 2.

Reassembly

1. Place the top half of the case upside down, then orient the rf board so its gold pins point up. Fit the board inside the case and over the plastic bosses (studs).
2. Slide the rubber grommets over the plastic bosses protruding through the rf board.
3. Fit the audio board over the rf board so that the sockets on the audio board line up with the pins on the rf board. Make sure the front panel is seated properly in the slot at the front of the case, that the battery terminals are inside the battery compartment, and that the bosses are just below the surface of the audio board.
4. Orient the the battery cover so its “Open” arrow points toward the antenna and will be on the outside. Fit the cover into the slots at the edge of the battery-compartment opening on the top case half (closed position).
5. Place the bottom half of the case over the audio board and align the edges of the case sections.

   Note: Make sure the front panel, battery clips, antenna, and connector pins are properly aligned and seated before joining the two case sections.
6. Align the two case sections and make sure they are properly seated before securing them with the two Phillips screws.

Replacing the Belt Clip

The belt clip is secured with a single Phillips screw. When replacing the clip, be sure to fit the section with the screw hole inside the square indentation in the rear case.

Service Procedures

Reference Material

Refer to the *Service Equipment Manual* for Shure standard test equipment.

Special Equipment

The *Service Equipment Manual* covers the standard items needed for servicing the transmitters. It also explains how to modify and use an SC4 receiver for testing any vhf microphone transmitter at the standard if frequency. If you do not have this receiver, you will need an appropriate receiver (usually an EC4) set to the same frequency as the transmitter.

System Operating Frequencies

Each rf board is marked with a group letter (A, B, or C) that identifies the range of frequencies on which the transmitter can operate. The letter is scratched into the underside of the rf board, near the part number for the bare (unpopulated) board.

Table 1
Rf Board Groups

Group	Frequency Range
A	169.000–190.000 MHz
B	190.050–210.000 MHz
C	210.050–230.000 MHz

Used with pcb assembly 90_8596A
(pcb marking 34A8476C)

Table 2 (page 8) lists the frequencies and frequency codes available on the EC1 plus the rf board group number needed to provide each frequency.

Changing the Frequency

The transmitter operating frequency is set by soldering jumpers across the appropriate solder pads on the back of the EC1 rf board, as shown in Figure 6 (page 19). Table 2 identifies the solder pads used for each frequency. Each location that requires a solder jumper is indicated by a “0” and shading; a “1,” unshaded, indicates a location that should not be jumpered. Complete these connections before tuning the transmitter.

You will also need to change the frequency of the matching EC4 receiver to match the new transmitter frequency (see the EC4 service manual).

Important: Remove any unwanted solder-bridging between jumpers.

Pc Board Groups

Table 2

Group	Freq. (MHz)	Model	I208 N_7	I207 N_6	I206 N_5	I205 N_4	I204 N_3	I203 N_2	I202 N_1	I201 N_0	I213 A_4	I212 A_3	I211 A_2	I210 A_1	I209 A_0
A	169.445	V	0	1	1	0	1	0	0	1	1	1	1	0	1
A	169.505	AD	0	1	1	0	1	0	0	1	1	1	1	1	0
A	170.245	AC	0	1	1	0	1	0	1	0	0	1	1	0	1
A	170.305	AH	0	1	1	0	1	0	1	0	0	1	1	1	0
A	171.045	AB	0	1	1	0	1	0	1	0	1	1	1	0	1
A	171.105	AG	0	1	1	0	1	0	1	0	1	1	1	1	0
A	171.845	W	0	1	1	0	1	0	1	1	0	1	1	0	1
A	171.905	AA	0	1	1	0	1	0	1	1	0	1	1	1	0
A	173.800	AQ *	0	1	1	0	1	1	0	0	1	0	1	0	0
A	173.800	EA	0	1	1	0	1	1	0	0	1	0	1	0	0
A	174.100	AY *	0	1	1	0	1	1	0	0	1	1	0	1	0
A	174.100	EB	0	1	1	0	1	1	0	0	1	1	0	1	0
A	174.400	CB	0	1	1	0	1	1	0	1	0	0	0	0	0
A	174.500	AZ *	0	1	1	0	1	1	0	1	0	0	0	1	0
A	174.500	DA	0	1	1	0	1	1	0	1	0	0	0	1	0
A	174.500	EC	0	1	1	0	1	1	0	1	0	0	0	1	0
A	174.800	BA *	0	1	1	0	1	1	0	1	0	1	0	0	0
A	174.800	ED	0	1	1	0	1	1	0	1	0	1	0	0	0
A	175.000	EE	0	1	1	0	1	1	0	1	0	1	1	0	0
A	175.000	BB *	0	1	1	0	1	1	0	1	0	1	1	0	0
A	175.600	FA *	0	1	1	0	1	1	0	1	1	1	0	0	0
A	176.000	FB *	0	1	1	0	1	1	1	0	0	0	0	0	0
A	176.200	CA	0	1	1	0	1	1	1	0	0	0	1	0	0
A	176.400	EF	0	1	1	0	1	1	1	0	0	1	0	0	0
A	177.000	K	0	1	1	0	1	1	1	0	1	0	1	0	0
A	177.250	DB	0	1	1	0	1	1	1	0	1	1	0	0	1
A	177.600	CC	0	1	1	0	1	1	1	1	0	0	0	0	0
A	177.800	FC *	0	1	1	0	1	1	1	1	0	0	1	0	0
A	178.350	FD *	0	1	1	0	1	1	1	1	0	1	1	1	1
A	180.400	CD	0	1	1	1	0	0	0	0	1	1	0	0	0
A	181.500	DC	0	1	1	1	0	0	0	1	0	1	1	1	0
A	182.200	CE	0	1	1	1	0	0	0	1	1	1	1	0	0
A	183.250	DD	0	1	1	1	0	0	1	0	1	0	0	0	1
A	183.600	CF	0	1	1	1	0	0	1	0	1	1	0	0	0
A	184.050	FE *	0	1	1	1	0	0	1	1	0	0	0	0	1
A	184.800	FF *	0	1	1	1	0	0	1	1	1	0	0	0	0
A	186.100	FG *	0	1	1	1	0	1	0	0	0	1	0	1	0
A	186.200	CG	0	1	1	1	0	1	0	0	0	1	1	0	0
A	186.600	CH	0	1	1	1	0	1	0	0	1	0	1	0	0
A	189.000	CJ	0	1	1	1	0	1	1	0	0	0	1	0	0

Group	Freq. (MHz)	Model	I208 N_7	I207 N_6	I206 N_5	I205 N_4	I204 N_3	I203 N_2	I202 N_1	I201 N_0	I213 A_4	I212 A_3	I211 A_2	I210 A_1	I209 A_0
B	190.600	CK	0	1	1	1	0	1	1	1	0	0	1	0	0
B	191.900	EG	0	1	1	1	0	1	1	1	1	1	1	1	0
B	192.200	CL	0	1	1	1	1	0	0	0	0	0	1	0	0
B	192.600	CM	0	1	1	1	1	0	0	0	0	1	1	0	0
B	195.000	CN	0	1	1	1	1	0	0	1	1	1	1	0	0
B	196.600	CP	0	1	1	1	1	0	1	0	1	1	1	0	0
B	198.250	DE	0	1	1	1	1	0	1	1	1	1	1	0	1
B	199.500	DF	0	1	1	1	1	1	0	0	1	0	1	1	0
B	200.300	CS	0	1	1	1	1	1	0	1	0	0	1	1	0
B	200.900	CZ	0	1	1	1	1	1	0	1	1	0	0	1	0
B	202.200	CQ	0	1	1	1	1	1	1	0	0	1	1	0	0
B	203.000	CR	0	1	1	1	1	1	1	0	1	1	1	0	0
B	203.500	DG	0	1	1	1	1	1	1	1	0	0	1	1	0
B	206.000	CT	1	0	0	0	0	0	0	0	1	0	0	0	0
B	208.200	CV	1	0	0	0	0	0	1	0	0	0	1	0	0
B	208.300	EH	1	0	0	0	0	0	1	0	0	0	1	1	0
B	209.000	CU	1	0	0	0	0	0	1	0	1	0	1	0	0
C	210.750	DJ	1	0	0	0	0	0	1	1	1	0	1	1	1
C	213.000	DK	1	0	0	0	0	1	0	1	0	0	1	0	0
C	216.100	EJ	1	0	0	0	0	1	1	1	0	0	0	1	0
C	216.750	DL	1	0	0	0	0	1	1	1	0	1	1	1	1
C	221.250	DM	1	0	0	0	1	0	1	0	0	1	0	0	1
C	222.250	DN	1	0	0	0	1	0	1	0	1	1	1	0	1
C	227.000	DP	1	0	0	0	1	1	0	1	1	1	1	0	0
C	229.000	DR	1	0	0	0	1	1	1	1	0	0	1	0	0

* These models have jumper X201 (see Figure 6, page 19) connected to lower the power output, which is part of the special requirements for these MPT1345 frequencies.

Alignment

The rf and audio alignments are generally done together, as a single, continuous procedure. Before beginning, be sure to do the setup described in the following subsection, “Test Conditions.”

Test Conditions

Initial Setup

1. Separate the rf board from the audio board.
2. Prepare the rf board as follows:
    - Solder a short, insulated wire to TP7 (figure 6, page 19). This wire must extend enough beyond the board to be accessed by a probe when the two pc boards are plugged together.
    - Obtain an RG174 (50 Ω coaxial) cable with a ferrite choke, a BNC connector at one end, and stripped leads at the other (see the service-equipment manual).
    - Unsolder and remove the antenna. Attach the 50 Ω coaxial cable’s center conductor to the antenna solder pad, and the shield to ground (see figure 5, page 19).
3. Plug the rf and audio boards back together.
4. Connect a 9 Vdc power supply to the battery terminals on the audio board: the green LED should glow.
5. On the audio analyzer, activate the 400 Hz high-pass and the 30 kHz low-pass filters.

RF Alignment

A: VCO Alignment

This small pc board is enclosed in a metal shield on top of the rf board. To access C409, remove the date-code label from the top of the shield.

1. Connect the dc-voltage probe to the wire you attached to TP7.
2. Adjust C409 for 4 Vdc (± 0.5 Vdc) at TP7.
3. Remove the wire from TP7.

B: RF Power Alignment

1. Plug the coaxial cable on the antenna output into the spectrum analyzer.
2. Set the spectrum analyzer as follows:
    - **Center Frequency:** *Carrier*
    - **Span:** *30 MHz*
    - **Reference Level:** *+20 dBm*
    - **Scale:** *10 dB/div*

3. Adjust C228 and C227 (rf board) for maximum power output.

   Note: To obtain the maximum output, set the spectrum analyzer to indicate 10 dB per division while you make the initial adjustments of C228 and C227. For their final adjustments, set the spectrum analyzer to 2 dB per division.

4. Check the carrier output power indicated on the spectrum analyzer The maximum conducted power measurement varies according to the applicable standard:

   - **MPT1345 (X201 jumpered):** *5 dBm to 10 dBm*
   - **MPT1350 (X201 open):** *8 dBm to 17 dBm*

   Note: After measuring the output power, add to it the calculated power (insertion) losses from the cables and connectors.

   In table 2 (page 8), frequencies marked with an asterisk are subject to standard MPT1345. They require a jumper at X201 to reduce the transmitter's output power.

C: Frequency Alignment

1. Remove the cable from the spectrum analyzer and connect it to the frequency counter through a 20 dB attenuator.

2. Adjust C243 to set the carrier frequency to FC ±1 kHz.

   Note: If you measure 4 V at TP7 but cannot adjust the carrier frequency to FC ±1 kHz, check the programming jumpers.

Audio Alignment

Make sure the microphone is turned on.

D: Gain

1. Unsolder and remove the 50 Ω coaxial cable, then resolder the antenna to the rf board.

2. Connect the audio analyzer's output to pins 3 and 1 of the unit's microphone input connector. If necessary, use an appropriate adapter cable.

3. Set the audio analyzer as follows:

   - **Frequency:** *1 kHz*
   - **Amplitude:** *32 mV*

4. Adjust the audio gain control (R115) for 0 dBu (0.775 Vrms), ± 0.5 dB, at TP4 on the rf board.

E: Deviation Reference Voltage

1. Turn off the EC1.

2. Connect the output of the audio generator to the modulation input of the rf signal generator.

3. Set the rf signal generator as follows:
   - **Frequency:** *Carrier*
   - **Modulation:** *FM*
   - **Modulation Source:** *Ext 1 kHz*
   - **FM Deviation:** ± *15 kHz*
   - **Amplitude:** *–38 dBm*
4. Set the frequency on the audio generator to 1 kHz and adjust the level until the “Hi Ext” and “Lo Ext” lights on the signal generator turn off.
5. To modify and use an SC4 receiver for testing at the if frequency, see the *Service Equipment* manual. Otherwise, obtain a receiver set to the same frequency as the transmitter (usually the EC4 that came with the unit) and prepare it as follows:
   - Disconnect the antenna(s) from the receiver input and connect the output of the rf signal generator to either antenna input of the receiver.
   - Set the *Volume* control on the front panel of the receiver to its maximum (fully clockwise) position and apply power to the receiver.
   - Set the receiver’s *Squelch* control to its midway position.
   - Terminate the receiver’s unbalanced output ($^1/_4$″ jack) with a 1 kΩ resistor.
6. The measured rms voltage at the unbalanced output should be 382 mV, ± 66 mV (between –4.8 and –7.8 dBu), which corresponds to a deviation level of 15 kHz. If it is not, the receiver needs tuning.

   Record this voltage as the Deviation Reference Voltage.

Note: At this point you may want to press the audio analyzer’s *Ratio* button (to perform the relative measurement in the next section) and its *Log-Lin* button (to display the measurements in dB).

F: Frequency Modulation Alignment

1. Turn off the rf output of the rf signal generator. Disconnect the output of the signal generator from the receiver. Connect an antenna to either antenna input of the receiver.
2. Verify that the audio analyzer’s output is connected to the microphone jack. Turn on the transmitter’s *Power* and *Mute* switches.
3. Set the audio analyzer as follows:
   - **Frequency:** *1 kHz*
   - **Amplitude:** *32 mV*
4. Measure the voltage at the high Z output ($^1/_4$″ jack) of the receiver. Adjust R204 so this voltage is within 1 dB of the deviation reference voltage measured in step 6 of the preceding subsection.

G: Frequency Response Test

1. Change the setup as follows:
   - Press the *Log/Lin* button on the audio analyzer (to measure in dBu).
   - Press the *Ratio* button twice to perform the next relative measurement.
   - Deactivate the 400 Hz high-pass filter on the audio analyzer.
   - Change the frequency of the audio generator to 100 Hz.
2. Verify that the audio level is +0 dB, –3 dB of your measurement in step 4, subsection F.
3. Activate the 400 Hz high-pass filter on the audio analyzer, and change the frequency of the audio generator to 10 kHz.
4. Verify that the audio level is ±1 dB relative to the 1 kHz voltage recorded in step 4 of subsection F.
5. Return the frequency of the audio generator to 1 kHz.

H: Audio Distortion Alignment

1. Set the audio analyzer to measure distortion (*Distn*). Verify that audio distortion is less than 0.5%. If distortion is greater, adjust R131 on the audio board for a minimum reading.

DC Current Test

1. Verify the transmitter current in the 9 V supply line is as follows:
   - **MPT1345 (X201 jumpered):** *60 mA (± 6 mA)*
   - **MPT1350 (X201 open):** *53 mA (± 6 mA)*

Notes

Replacement Parts and Drawings

On the next page, the parts are listed according to the designations from the pc board (see figures 3 through 8, on pages 18 through 20) and the schematics at the end of this manual. Parts shown on the circuit diagram and not listed below are available at electronic-parts distributors.

On the pages following the parts list are the drawings of the printed circuit boards and the schematics.

Product Changes

This section briefly describes significant changes to the EC1.

Microphone Jack: In 1994, the microphone-jack board was changed to the “B” version, which accepts a WA302 guitar cable. The change included new values for C301 and C302 on the jack board, and to C104 and R119 on the audio board. It also changed the input impedance from 100 Ω to 1 MΩ.

Battery Terminals: In 1995, the battery clips were changed to stainless steel. The present version may be used as a direct substitution on earlier models.

Dual Operational Amplifier (U106): Temporary shortages of the Shure part number 183A02 necessitated various substitutions. The present part number may be used to replace any of those earlier substitutes at U106 on the audio board.

“J” Frequency Code: Starting in the summer of 1997, EC Series transmitters and receivers tuned to 175.000 MHz have been labeled as “BB” rather than “J.” The change was made to avoid confusion with the different meaning of the “J” designation in the LX88 and ELX88 units. It is only a labeling change; the units are physically the same. The relabeling does not apply to other 175 MHz units (e.g., EE).

Parts Designations

The following comments apply to the parts list and the schematic:

Resistors: All resistors are surface-mount with $^{1}/_{10}$ W rating and 1% tolerance.

Capacitors: Unless otherwise noted, non-polarized capacitors are surface-mount NPO dielectric types with a $\geq$50 V capacity.

Table 3
Replacement Parts

Reference Designation	Description	Shure Part No. (commercial alternative)
A1	Audio pcb assembly	90B8449J
A2	Rf pcb assembly	90_8596A [in the underlined space, insert the proper letter code from the “Group” column in table 2 (page 8)—e.g., 90B8596A].
A3	Microphone-jack pcb assembly	90B8420B
E201	Antenna	70B8007
MP1	Case front	65A8173
MP2	Case back	65A8139
MP3	Belt clip	53A8247B
MP4	Battery door	65A8226
Audio Circuit Board		
D101	Light-emitting diode (green)	86C8422
J101, J102	Socket strip	56A8041
MP3	Battery clip	56A8066
Q101, Q104, Q105	Transistor, NPN	183A38 (MMBT5089LT1)
Q102, Q103	Transistor, PNP	183A01 (MMBT5087T)
Q106	Transistor, PNP	183A07 (MMBT404AL)
R115	Trim pot, 5 k, log	46D8008
R131	Potentiometer	146F02
S101	Slide switch, spdt	55B8048
S102	Slide switch, spdt	55C8048
U101	Integrated circuit	188A01 (NE571D)
U106	Dual operational amplifier	188A02 (TL062ACDR)
Mic-Jack Board		
J1	Four-pin receptacle	95A8188
RF Circuit Board		
A201	Voltage-controlled oscillator assembly	90_8597A [in the underlined space, insert the proper letter code from the “Group” column in table 1 (page 7)—e.g., 90C8597A].
C227, C228	Trim capacitor (3–10 pF)	152C02
C243	Trim capacitor (7–50 pF)	152H02
P201, P202	Interconnect strip	56A8042
Q201	Transistor, NPN	183A03 (MMBTH10L)
Q204	Transistor, NPN	183A17 (NE73433)
R204	Potentiometer, 5 k, 25%	146D02
U201	Integrated circuit-synthesizer	188A16 (MC145152FN2)
U202	Integrated circuit-prescaler	188A15 (MB504L)
U203	Single operational amplifier	188A14 (MC33171D)
Y201	Crystal (6.4 MHz)	140A002

Reference Designation	Description	Shure Part No. (commercial alternative)
Voltage-Controlled Oscillator Board (mounted inside the shield on the rf board)		
Q401	Transistor, vhf/uhf (N channel)	183A18 (MMBFJ310L)
Q402	Transistor, dual-gate agc amp, GaAs MESFET (gallium-arsenide metal-oxide semiconductor field-effect transistor)	183B12 (NE25139/U72)

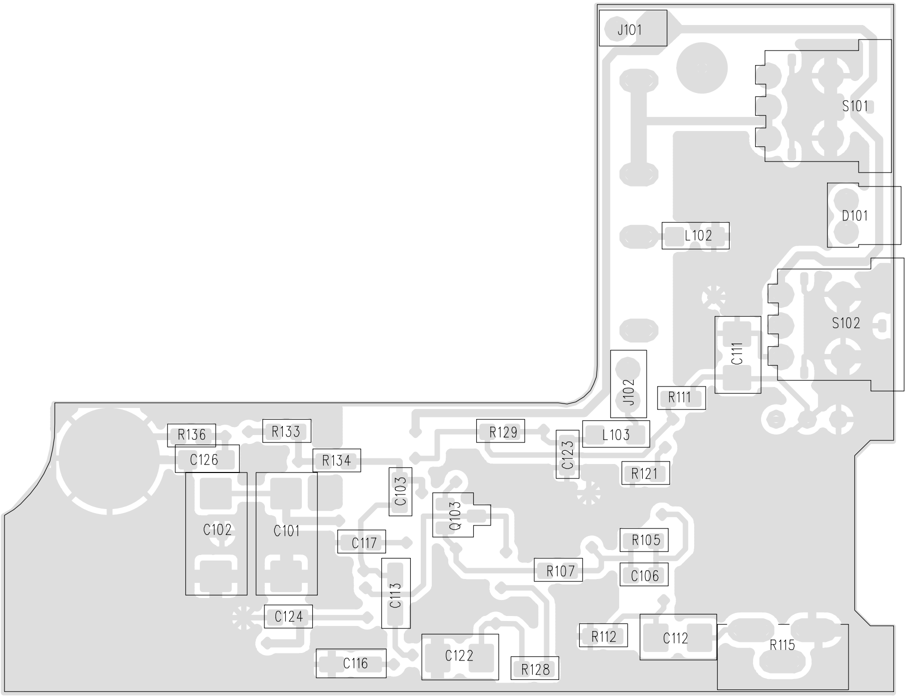


Figure 3. EC1 Audio Board, Top

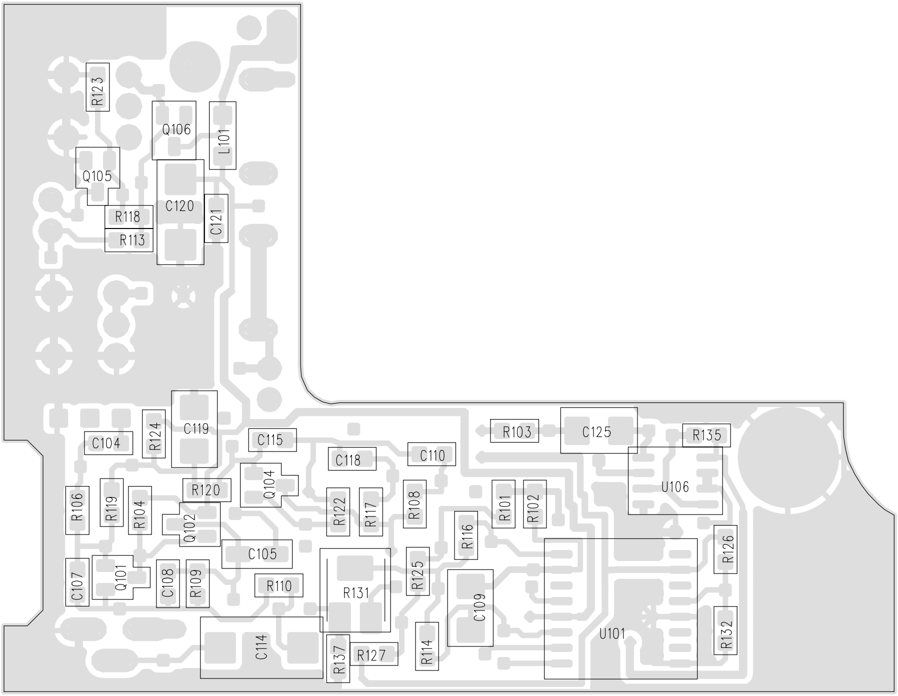


Figure 4. EC1 Audio Board, Bottom

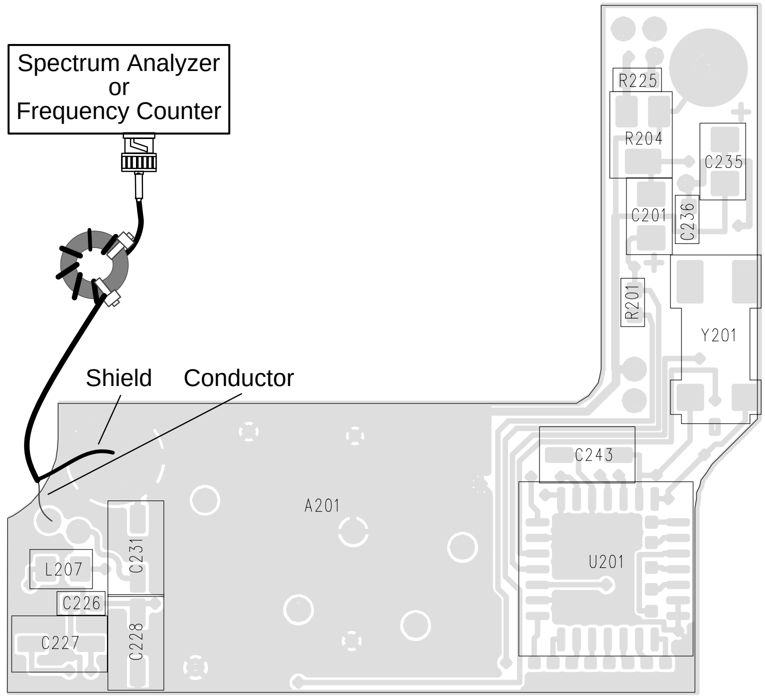


Figure 5. EC1 RF Board, Top

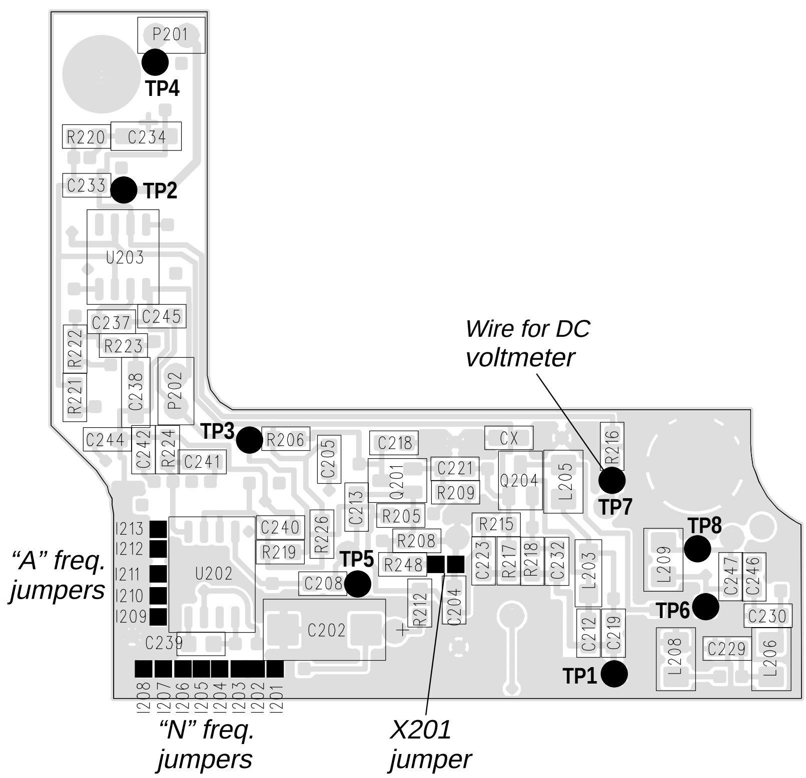


Figure 6. EC1 RF Board, Bottom

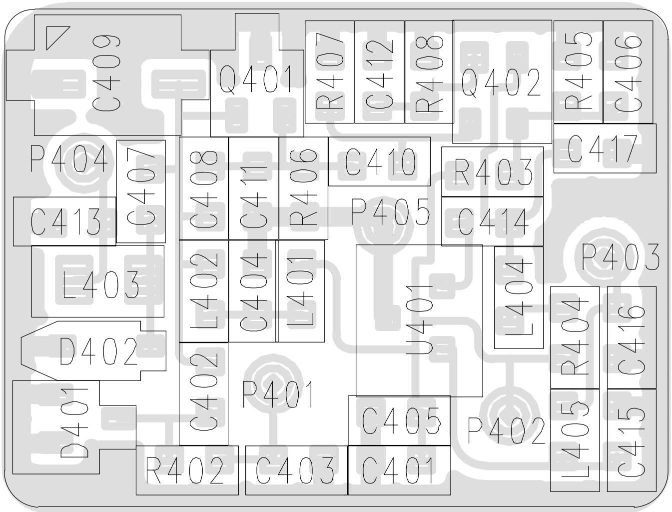


Figure 7. EC1 VCO Board, Top

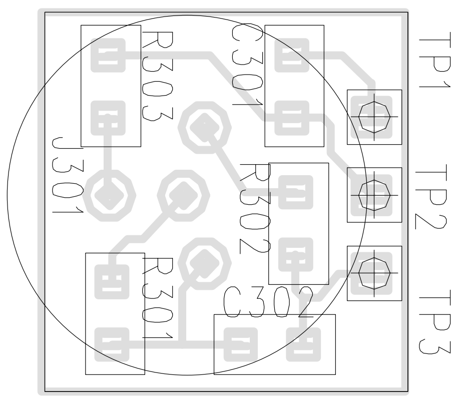


Figure 8. EC1 Microphone-jack Board, Bottom

Schematics

(Note to Printer: do not print this page)

Please print the attached schematics in the order they are listed:

- EC1 Audio Board (letter size)
- EC1 Rf Board (ledger size)
- EC1 VCO Board (ledger size)